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APPLICATION OF REMOTE SENSING TECHNOLOGY TO LAND EVALUATION, PLANNING UTILIZATION OF LAND RESOURCES, AND ASSESSMENT OF WILDLIFE AREAS IN EASTERN SOUTH DAKOTA

FOR

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GRANT NO. NGL 42-003-007

REMOTE SENSING INSTITUTE
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ABSTRACT

The use of remote sensing technology to develop soils maps for land evaluation for tax equalization has been demonstrated in western South Dakota. However, procedures have not been developed for the more diverse glaciated terrain of Eastern South Dakota. The major objective of the present study is to develop a soils map for land evaluation in Potter County (Eastern South Dakota) to demonstrate the use of remote sensing technology in the area of diverse parent materials and topography. General land use and soils maps have been developed for land planning, also. LANDSAT, RB-57 imagery, and USGS photographs are being evaluated for making soils and land use maps. LANDSAT fulfilled the requirements for general land use and a general soils map. RB-57 imagery supplemented by large scale black and white stereo coverage were required to provide the detail needed for the final soils map for land evaluation. Color infrared prints excelled black and white coverage for this soil mapping effort.

An identification and classification key for wetland types in the Lake Dakota Plain has been developed for June 1975 color infrared imagery. Wetland types in the region are now being mapped via remote sensing techniques to provide a current inventory for development of mitigation measures.

Recent applications of the rooftop survey program and other technology developed under NASA funding are summarized.

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ACKNOWLEDGEMENTS

The Potter County Project was supported in part by the State of South Dakota and the National Aeronautics and Space Administration (NASA) Grant No. NGL 42-003-007. Appreciation is extended to the NASA technical offices (Mr. Joe Vitale) for support and direction of the project.

Appreciation is also extended to Mr. Robert Borszich (Director of Equalization, Potter County) for his continued interest and support in the land evaluation study.

APPLICATION OF REMOTE SENSING TECHNOLOGY TO LAND EVALUATION, PLANNING UTILIZATION OF LAND RESOURCES, AND ASSESSMENT OF WILDLIFE AREAS IN EASTERN SOUTH DAKOTA

INTRODUCTION

The major objective of this project is to provide remote sensing technology for two programs, each with important applications involving decisions by public agencies. The studies are: (1) application of remote sensing technology to land evaluation and planning utilization of land resources in Eastern South Dakota and (2) assessment of wildlife habitat in relation to the proposed Oahe Irrigation Project.

LAND EVALUATION AND PLANNING UTILIZATION OF LAND RESOURCES

The 1971 South Dakota Legislature enacted a law requiring agricultural lands to be taxed according to their ability to produce agricultural crops or native grasses. Crop and range yields are available for the soils of South Dakota, and Westin, et al. (1974) developed procedures for relating soils, yield and land values in 1972. However, forty of the sixty-seven counties of the state do not have the soils information necessary for the evaluation. Just over one-half of the counties east of the Missouri River lack the soils information for compliance with the law, and Potter County is one of these.

Remote sensing can provide the base data and information necessary for a soil survey at the soil association level. Basic procedures must be developed to relate the soils maps to land values in the Eastern South Dakota area and to develop related thematic maps of land values. Tax assessors from counties throughout the state have indicated enthusiastic acceptance and use of procedures developed in the Pennington study and are continually requesting that similar studies be made for the more intensely farmed eastern area. Several individuals expressed a desire for the study underway in Potter County located adjacent to the Missouri River in Eastern South Dakota. A copy of a letter from Mr. Wilfred C. Fischer, Chairman of the Potter County Board of Commissioners, stating his willingness to cooperate in the Potter County study, is attached in Appendix A. An earlier letter from the Potter County Director of Equalization requesting the study is included.

POTTER COUNTY LAND EVALUATION STUDY

Potter County has been recently glaciated. Pennington County was not glaciated and soils are developed on essentially horizonal beds of sedimentary rocks and terrace materials. The glaciated terrain contains a much greater diversity in parent materials and topography than the unglaciated areas of the state. Soils of Potter County are developed in wind-blown loess, glacial till, shale, glacial outwash and alluvium. Much of the county has poorly developed drainage systems and much of the drainage is interior resulting in clay pots and wetlands.

Potter County is more intensively used for cropland than Pennington County, which is principally range land. Land holdings in Potter County are of considerably smaller size than those in Pennington County. Because of the greater diversity of the glaciated landscapes, the more intensive cropping and the smaller land holdings in Potter County, the soils information used for tax equalization must be of considerably greater detail than that used for Pennington County.

The large increase in land value in the past few years and the continuing insistence by the State Legislature of the Department of Revenue to implement the 1971 law gives further importance to the project. According to the 1971 law, the counties of South Dakota are to have comprehensive plans developed by July 1, 1976. Much of the data needed for such plans are lacking throughout the state. A demonstrated use of remote sensing techniques for development of land use and soils data has been completed in Meade County. A similar approach is being used in Potter County to further demonstrate the use of remote sensing for land use planning in eastern South Dakota. Since many existing remote sensing techniques are unknown to potential users, continued contact with these people has been necessary. Efforts to acquaint user groups with remote sensing are being conducted.

PROCEDURES AND PROGRESS

LANDSAT, RB-57 imagery, and USGS photography have been evaluated for making soils and land use inventories in the diverse, glaciated

terrain of Potter County. The technology developed in the previous NASA sponsored research efforts is being utilized where applicable in eastern South Dakota. The procedures used and work implemented in Potter County are as follows:

1. Preliminary meetings have been held with the county commission and the director of equalization to explain the use of remote sensing for land evaluation.
2. LANDSAT imagery at 1:125,000 was visually interpreted to provide a land use map for Potter County for use in their comprehensive planning effort. Interpretations were ground checked on RB-57 photography taken in June 1975.
3. Existing techniques and available imagery have been evaluated for mapping soils for tax equalization. A soils inventory from LANDSAT imagery at scales of 1:125,000 and 1:250,000 has been compiled. Although the resulting map was an improvement over the general soil association map, the detail was insufficient for use by the director of equalization. High altitude RB-57 imagery was used in conjunction with low altitude aircraft imagery to further distinguish soil areas.
4. The interpreted soil area delineations were field checked for accuracy to ensure the proper soil description for each area.
5. The soil areas are now being grouped by their productivity based on yield data for each of the soil components comprising the areas.

The land use assessments have been furnished to the planning personnel of Potter County and their regional planning office to aid in the compilation of the county comprehensive plan. The land evaluation data will be furnished to the Director of Equalization on completion.

GENERAL LAND USE

The land use classifications used for Potter County provide a broad overview of the existing land use patterns for countywide planning. Boundary distinctions were made for each category (Figure 1) with the aid of June 1975 RB-57 infrared imagery combined with several different

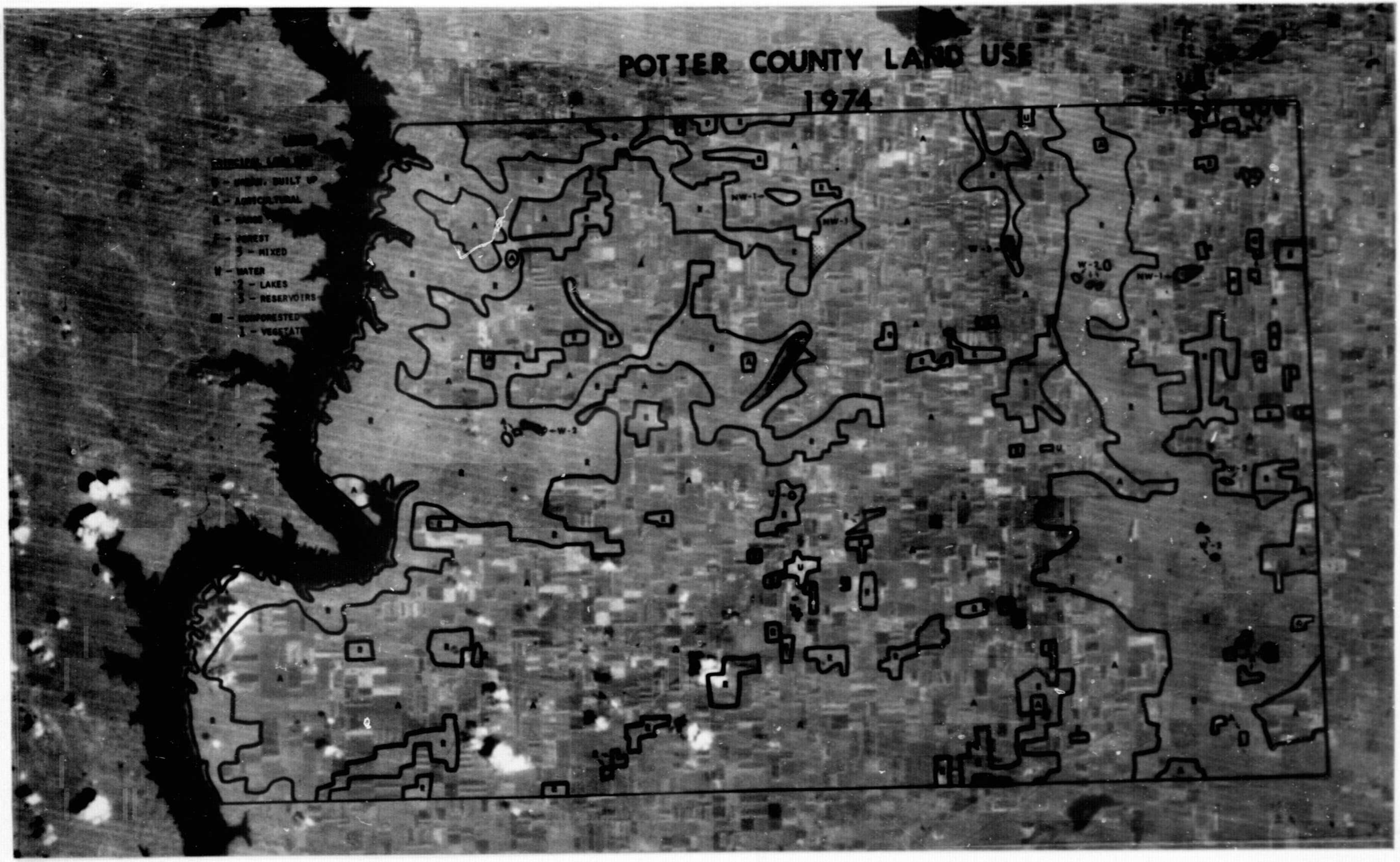

Figure 1. Level I Land Use for Potter County on a LANDSAT-1 color composite of bands 4, 5, and 7 on June 15, 1974. (NASA ID 1692-16535; RSI No. 825). Scale is approximately 1:350,000.

dates and bands of LANDSAT imagery. For example, a black and white (band 7 March 21st) negative LANDSAT image was used to locate the major water bodies in the county. On that image the waterbodies were white to light gray, (dark blue on the color composite), providing distinct water-land boundaries for mapping purposes. The tonal variations in the two images were caused by the change in reflectances at the different scanning dates. On March 21st the majority of the water bodies were still frozen, while on June 15 the lakes were ice free.

Urban areas such as Gettysburg were represented by white to gray tones on the color composite (Figure 1) and gray to dark gray tones on the black and white band 5 image. Agricultural lands, which were being cropped, were represented by red and pink tones on the color composite; red represents the more mature broader leafed crops. Fields which have been plowed and fields which have relatively little (or ripe) crop cover are represented by dark and light tones, respectively, on the color composite.

Range and pasture land appeared brownish green to light pink on the color composite. The main reason for these variations in tones lies in the differentiation between range (unimproved grassland, brownish green) and pasture (improved grassland, pink). Slope was also an important factor in reflectance patterns.

In several instances areas designated as nonforested wetlands had open water bodies within them. Close inspection combined with supplemental imagery, however, showed that marshy vegetation was found in and on the edges of these water bodies. Exact identification of these areas was made difficult by factors such as drought, rainfall, and seasonal fluctuations in water levels. One field which typified such an area is indicated by a dot pattern in the upper center portion of the color composite. In wet years this area is probably used for pastureland, while in dry years it could be cropped.

There is only one area classified as forested land (mixed). The area is a small state park on the Missouri River. Definitions of the land use categories delineated are listed in Table 1.

TABLE I. LAND USE CATEGORIES FOR POTTER COUNTY

DEFINITIONS OF LAND USE CLASSES *

1. Urban and Built-Up Land. Areas of intensive use with most of the land covered by structures. This category includes residential, commercial, industrial, mining, transportation, utility, recreational, and institutional areas. These areas may occur in cities, towns, villages, strip developments along highways, or as isolated units.

2. Agricultural Land. Areas used primarily for production of crops.

3. Rangeland and Pasture. Areas used primarily for grazing of livestock and hay production. This category includes the short and midgrass rangelands in the steep shale breaks as well as the hilly morainic areas.

4. Forest Land. Areas covered by or influenced by trees. This category includes lands covered by both evergreen and deciduous trees.

5. Water. Areas covered by water which are at least 1/8 mile wide and cover approximately 40 acres or more. This category includes lakes, reservoirs, and large farm ponds.

6. Nonforested Wetlands. These areas consist of seasonally flooded basins and flats, meadows, marshes, and bogs. These wetlands are relatively level areas.

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* These definitions are based upon the publication: "A Land-Use Classification System for Use with Remote Sensor Data," by Anderson, Hardy, and Roach, U.S. Geological Survey Circular 671, and are localized for Potter County.

GENERAL SOILS MAP

LANDSAT imagery was evaluated as a source of data for mapping soils in Potter County. Although the data provided a good general soils map for the area for county planning, the resulting map (Fig 2) was of insufficient detail for use by the Director of Equalization for tax equalization. Soil descriptions for the map are in Table 2. The LANDSAT composites (May and June) of bands 4,5 and 7 provided good general data on the distribution of cropland and rangeland, which are important land use categories when evaluating land areas and mapping soils. Some of the mixed, darker toned areas of little geometric pattern were indicative of poorly drained areas with claypan subsoils. The shale breaks adjacent to the Missouri River were very apparent due to lack of cropland and related crop patterns. The distinctive glacial end moraine located in the eastern portion of the county was apparent by its lack of cropping, its hilly nature and abundance of potholes (claypans) noted in this area of ill-defined drainage and closed depressions. The ill-defined drainage was apparent on the May LANDSAT composite at 1:125,000, but much more detail on the drainage of this and other areas was noted on the Band 7 image in March. Bands 5 and 7 (1:125,000) from December 1973 were used individually and provided tonal patterns indicative of non-cropped areas of moderate to hilly relief. A snow-covered band 7 print from December 1976 at 1:250,000 provided much additional data features of Potter County.

In addition to field checking, RB-57 imagery was utilized for ground truth of LANDSAT data for the general soils interpretations.

SOIL MAPPING FOR LAND EVALUATION

Use of RB-57 Imagery

Although LANDSAT provided data for a good general soils map, additional detail was required to map Potter County soils for land evaluation. Therefore, to provide the additional data and detail required, 1:120,000 stereo coverage RB-57 imagery of Potter County was taken in late June, 1975. Color and infrared color transparencies were supplied to the RSI by NASA. Color IR prints were made for Potter County at a scale of 1 inch = 1 mile (1:63,360). The prints were viewed stereoscopically

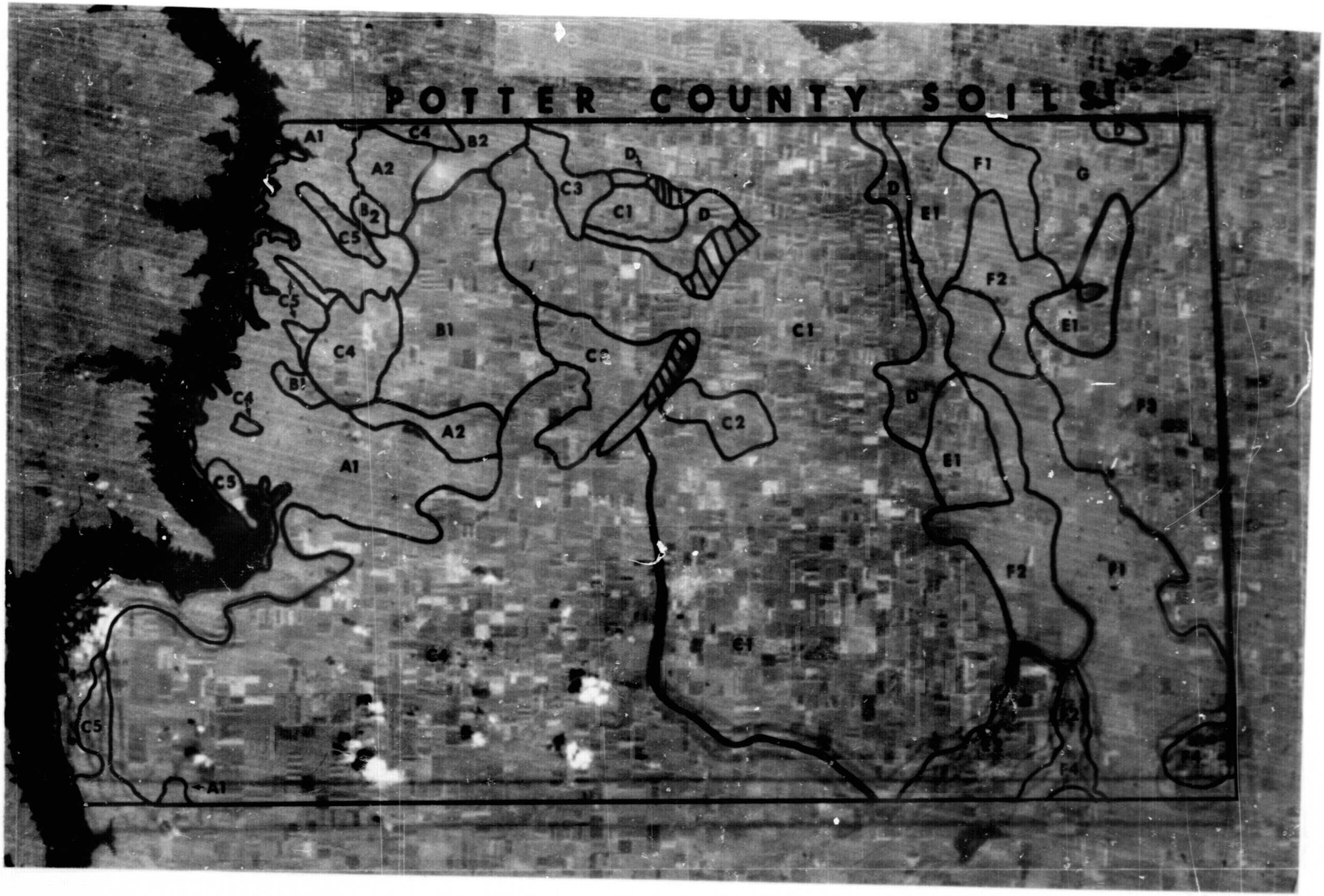


Figure 2. General soil map for Potter County on a LANDSAT-1 color composite of bands 4, 5, and 7 on June 15, 1974. (NASA ID 1692-16535; RSI No. 825). Areas within heavy lines were not seen on LANDSAT but were derived from field checking and/or Soil Conservation Service data. Scale is approximately 1:350,000.

TABLE II. DESCRIPTIONS OF GENERAL SOILS OF POTTER COUNTIES

A. Clayey soils formed over Pierre Shale (Missouri River Breaks)
- A1 Strongly sloping to steep shallow soils
- A2 Sloping soils moderately deep over clay

B. Well-drained clayey soils formed in residuum over clay shale
- B1 Undulating to rolling moderately deep soils formed
- B2 Nearly level to rolling deep soils

C. Well-drained silty soils that formed primarily in loess and silty glacial drift on uplands
- C1 Nearly level to gently undulating deep soils formed in glacial drift on uplands
- C2 Undulating deep soils formed in glacial drift
- C3 Sloping to hilly deep to moderately deep soils formed in glacial drift
- C4 Nearly level to sloping deep soils formed in loess
- C5 Gently undulating to rolling deep to moderately deep soils formed in loess

D. Nearly level, deep poorly drained silty soils with claypan subsoils formed in local alluvium on bottomlands

E. Well-drained silty and loamy soils over sand and gravel
- E1 Nearly level moderately deep soils over gravel on outwash plains
- E2 Nearly level to sloping moderately deep soils over sand and gravel on outwash plains and terraces

F. Well-drained loamy soils formed in glacial till on uplands
- F1 Rolling to hilly deep loamy soils
- F2 Undulating to rolling deep loamy soils
- F3 Gently undulating to undulating deep soils
- F4 Nearly level to gently undulating deep soils

G. Gently undulating to rolling deep silty and loamy well-drained soils formed in glacial drift and glacial till on uplands.

to provide information for delineating soils of different slope classes and relief patterns. Vegetation patterns (enhanced by color infrared) apparent on the imagery provided information on clayey soils and soils not cropped because of various limitations (Figure 3). The data were especially useful in the prominent clay shale breaks adjacent to the Missouri River (West Potter County) and the hilly end moraine (East Potter County) consisting of numerous poorly drained areas.

Poorly drained (clayey) soils in loess covered areas were also easily recognized and delineated by tonal differences in vegetation.

However, the glaciated terrain of Potter County presented such a diversity of parent material and topography that the RB-57 imagery did not completely fulfill the data source believed necessary for land evaluation. The RB-57 imagery provided most of the major soil delineations while the B&W photos provided more detailed topographic data necessary to delineate soils in the very diverse terrain.

Use of USGS Photography

USGS B&W stereo photography (1969 and 1973 coverage) was also acquired for Potter County. The photos were acquired for two reasons: 1) The director of equalization (Robert Borszich) requested that the final soil lines be transferred to these photos for use in his office for inquiries, etc. and 2) as a source of detailed information (low altitude, stereo coverage) that might be required to map the more diverse soilareas in the County.

Photo index sheets for the B&W photography were used in the field for preliminary delineation of soils and for marking sampling points. The B&W photos were then viewed stereoscopically in the lab to locate additional lines and finalize the delineations and to map areas not apparent on the RB-57. The large scale B&W coverage was especially useful in following the diverse terrain and finalizing boundaries for soils in different slope classes. The photography also provided an excellent background for the soil lines in the highly rural county.

ASSESSMENT OF WILDLIFE HABITAT

THE PROBLEM

The Fish and Wildlife Service (F&WS) and state game and fish agencies have been engaged in a wetland-preservation program since 1956. Wetland inventories are an essential part of this program, providing data required for wetland aquisition planning. Inventories of the temporary wetlands which exist within the irrigable lands of the Oahe project must be completed to formulate mitigation plans to replace those lost in irrigation development. The original inventory prepared for the impact statement which was required before the irrigation project could be initiated was based upon a statistical subsample to represent the total area. Due to the dynamic nature of the temporary wetlands and the rapidity of land use changes another inventory was suggested. The first activity pursued was a joint effort between personnel from RSI and the F&WS to define the wetland types which exist in the irrigable land of the Oahe project. Ground level oblique photos were collected to illustrate each wetland type and the vegetative species which are common to each. Photo interpretation techniques were developed to identify and classify the wetlands of the Oahe irrigation area from the color infrared RB-57 imagery collected 27 June 1975. The following report is a documentation of the interpretation techniques developed to identify and classify the wetland basins which exist in the irrigable land of the Oahe project. The next and ongoing step is to apply the procedures to the study area and furnish the data and statistics to the F&WS and other cooperating agencies for decision making. Close communication is being kept with the F&WS, etc. to provide the data desired in a timely, acceptable manner.

DESCRIPTION OF THE LAKE DAKOTA PLAIN

The land selected for irrigation in the initial phase of the Oahe irrigation project lies primarily in the Lake Dakota Plain. The Lake Dakota Plain is part of the James River Lowland and is characterized by lack of relief. This flatness results from the deposition of sediments in Glacial Lake Dakota, which existed during the last deglaciation

of the region (flint, 1955). Local relief in many places is less than 10 ft. The area is drained by the James River which flows along its central axis.

A large number of small, shallow wetland basins exist in the area. The basins contain water for only short periods following snow melt or periods of high rainfall and are usually dry during most of the growing season. Inventories of these basins are complicated by their relatively small size and by the fact that most of them are tilled and planted to small grains.

DEVELOPMENT OF WETLAND KEY

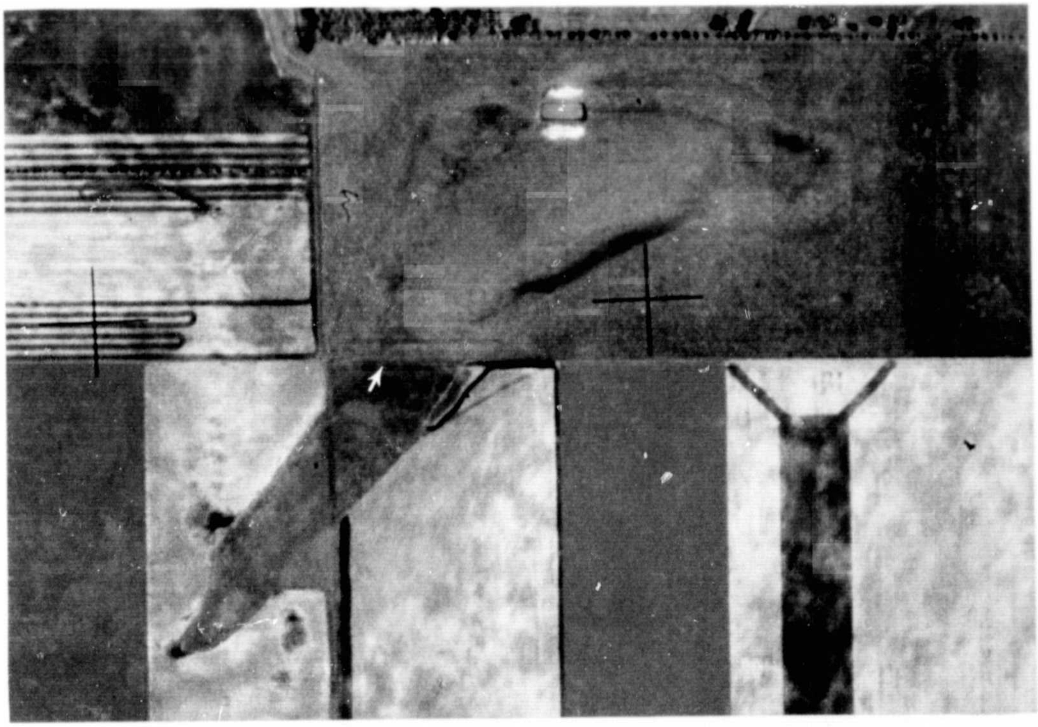
Martin et al (1953) developed a wetland classification system which classifies wetlands according to both water regime and their usefulness to waterfowl. Shaw and Fredine (1971) described the 20 wetland types that Martin et. al. classified, of which only four types exist in the Lake Dakota Plain. All four types are categorized as inland fresh areas but differ in morphology.

Seasonally flooded basins or flats (Type 1) are the most abundant in the region, not only in number but also acreage. The basins contain water for short periods, generally in the spring following snowmelt or periods of heavy rainfall. They are used extensively by migrating waterfowl during their spring migration. Vegetation varies depending on the duration of inundation and the season. However, smartweeds (*Polygonum* sp.) and wild barley (*Hordeum jubatum*) are plants common to the Type 1's in the region (Fig. 3). The basin is usually dry during much of the growing season and most basins are tilled and planted to small grains. Wetland basins in non-tilled lands were easily identified on the color infrared imagery collected during early spring. The wetland vegetation reflected higher in the infrared than did surrounding vegetation (see Fig. 4 and 5). Those basins which were in fallow fields could be delineated by dark tones and smooth texture on the color infrared imagery (see Fig. 6). The extent of the basin normally included the waterlogged soils as well as the standing water. This is important to note because the standing water may last for only several days while the waterlogged soils persist for longer periods. Type 1 wetlands

Smartweeds (Polygonum sp.)

Wild Barley (Hordeum jubatum)

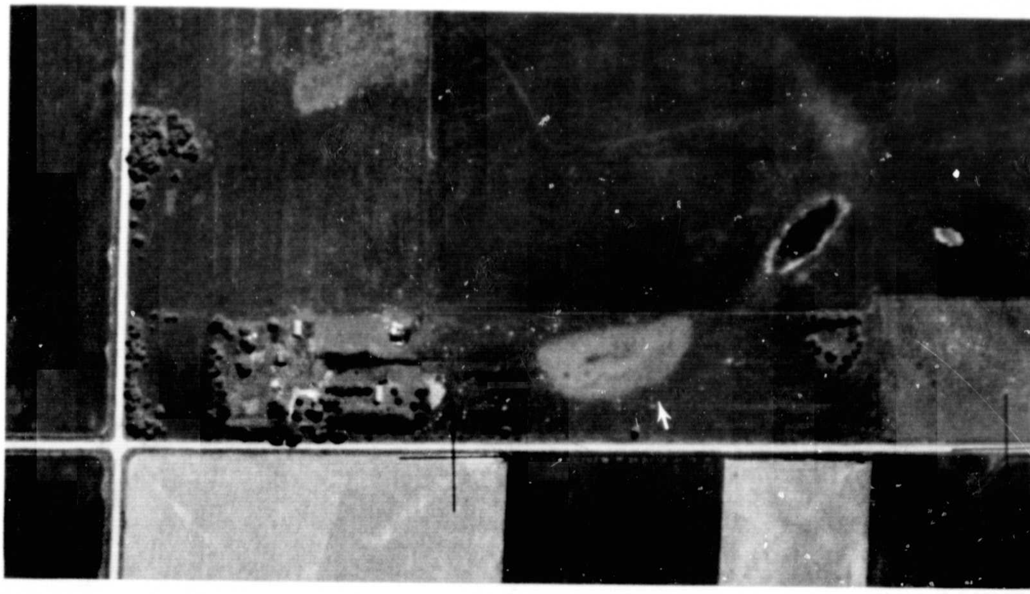
Fig. 3. Oblique hand-held photography illustrating the wetland vegetation common to seasonally flooded basins and flats (Type 1) in the Lake Dakota Plain of Eastern South Dakota.



Color-infrared image of Type 1 wetland. (Scale ≈ 1:8,000 Arrow denotes position of ground-level oblique. RB-57, Ziess, 12" fl, 27 June 75)

Ground-level oblique of the above Type 1 wetland. (27 June 75)

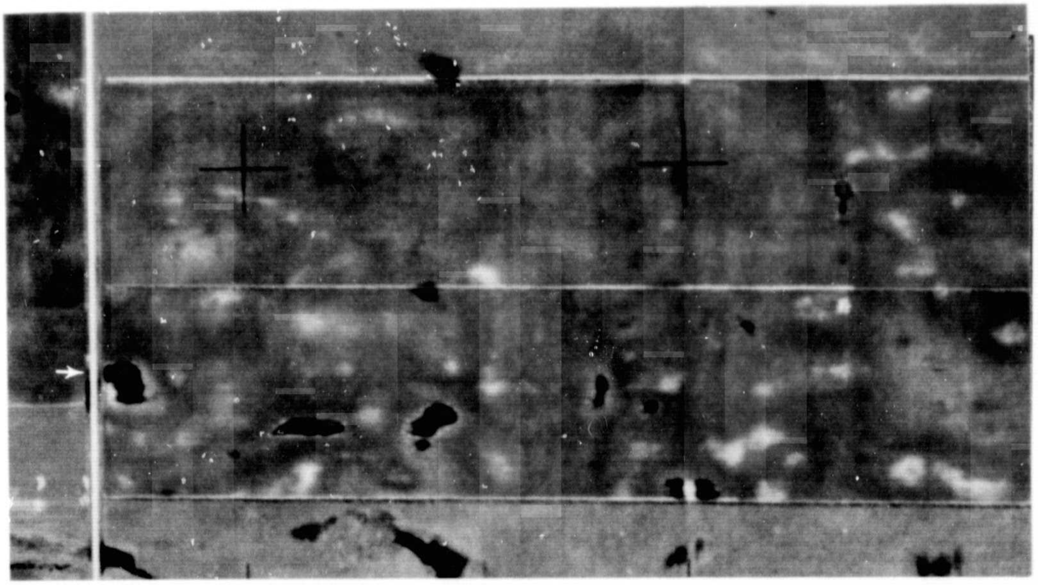
Fig. 4. Example interpretation of Type 1 wetland in non-tilled lands of Lake Dakota Plain.



Color-infrared image of Type 1 wetlands. (Scale ≈ 1:8,000 Arrow denotes position of ground-level oblique. RB-57, Ziess, 12" fl, 27 June 75)

Ground-level oblique of above Type 1 wetland. (27 June 75)

Fig. 5. Example interpretation of small Type 1 wetland in non-tilled land of Lake Dakota Plain.



Color-infrared image of Type 1 wetlands. (Scale ≈ 1:8,000 Note the extent of wetlands includes not only standing water but also the surrounding waterlogged soils. (Arrow denotes position of ground level oblique RB-57, Zeiss, 12" fl, 27 June 75)

Ground-level oblique of above Type 1 wetland. (27 June 75)

Fig. 6. Example interpretation of Type 1 wetlands in fallow field in Lake Dakota Plain.

in growing fields of small grain were the most difficult to delineate because the growing grain masked the interpretation of basin extent (see Fig. 7). Only that portion of the basin which contained water could be interpreted on the imagery. Optimum conditions for data collection would therefore be early in the spring when basins are full of water and the soils are essentially fallow. It may also be possible to delineate the basin on imagery collected after the small grain is harvested, because in many cases wetland vegetation, primarily smartweed, will grow in the basin during these dryer periods of the year (see Fig. 8).

Inland shallow fresh marshes (Type 3) are the second most common type in the region. In the Type 3 the soil is usually waterlogged during the growing season and is often covered by 15 cm (6 inches) or more of water. They are also common as seep areas on irrigated lands. Wetlands of this type are used extensively as nesting feeding, and early brood rearing habitat by waterfowl. Tillage of Type 3 occurs only after prolonged dry periods. Vegetation includes, bulrushes (Scirpus sp), spike rushes (Eleocharis sp), giant burreed (Sparganium sp) and various other marsh plants (see Fig. 9). In general the depth of the water does not limit the growth of marsh vegetation in the central portion of the wetland and many contain closed stands of emergent vegetation. Type 3 wetlands can be interpreted on color infrared imagery by the presence of water in early spring with an abundance of marsh vegetation throughout the basin (see Fig. 10). Wetlands do not fit into exact type classification. Therefore, type 3 and inland deep fresh marshes (Type 4) often have some degree of overlap and are difficult to differentiate.

The Type 4 wetlands usually have 15 cm (6 inches) to 1 m (3 feet) or more of water during the growing season. Deep fresh marshes are the best breeding habitat in the country and in combination with type 3 wetlands constitute the principal production areas for waterfowl. The emergent vegetation is similar to that of a Type 3 (Fig. 9), with increasing densities of Scirpus sp and Typha sp but in areas where water depth limits emergent growth, floating leafed aquatics are common.

Color-infrared image of Type 1 wetlands. (Scale ≈ 1:8,000 Arrow denotes position of ground-level oblique. RB-57, Ziess, 12" fl, 27 June 75)

Ground-level oblique of above Type 1 wetlands. (27 June 75)

Fig. 7. Example interpretation of Type 1 wetlands in tilled-lands of Lake Dakota Plain.

Fig. 8. Ground-level oblique illustrating the presence of smartweed in Type 1 wetland (fig. 5) after harvest of small grain crop. (8 Nov. 75)

A. cattail (Typa. sp.)
B. grant burred (Sparganium eurycorpum)
C. river bulrush (Scirpus fluviatiles)
D. spike rush (Eleocharis sp.)

Fig. 9. Oblique hand-held photography illustrating the emergent vegetation common to inland shallow fresh marshes (Type 3) or inland deep fresh marshes Type 4 in the Lake Dakota Plain.

Color-infrared image of Type 3 wetland. (Scale ≈ 1:8,000 Arrow denotes position of ground-level oblique. RB-57, Ziess, 12" fl, 27 June 75)

Ground-level oblique of the above Type 3 wetland. (27 June 75)

Fig. 10. Example interpretation of Type 3 wetland in the Lake Dakota Plain.

During periods of normal precipitation Type 4 wetlands can be distinguished from Type 3 wetlands because they usually have a greater percentage of open water occurring in the central portion of the basin (see Fig. 11). If high water levels are maintained for long periods, emergent vegetation may be excluded from the entire central portion of the basin. Peripheral bands of vegetation, common to shallower types, (i.e., wild barley) are often present around deep marshes in shallow portions of the basin. When delineating the extent of the basin this "band" should be included. This band of vegetation is evident on the color infrared imagery because of the higher infrared reflectance of the emergents in early spring (see Fig. 12).

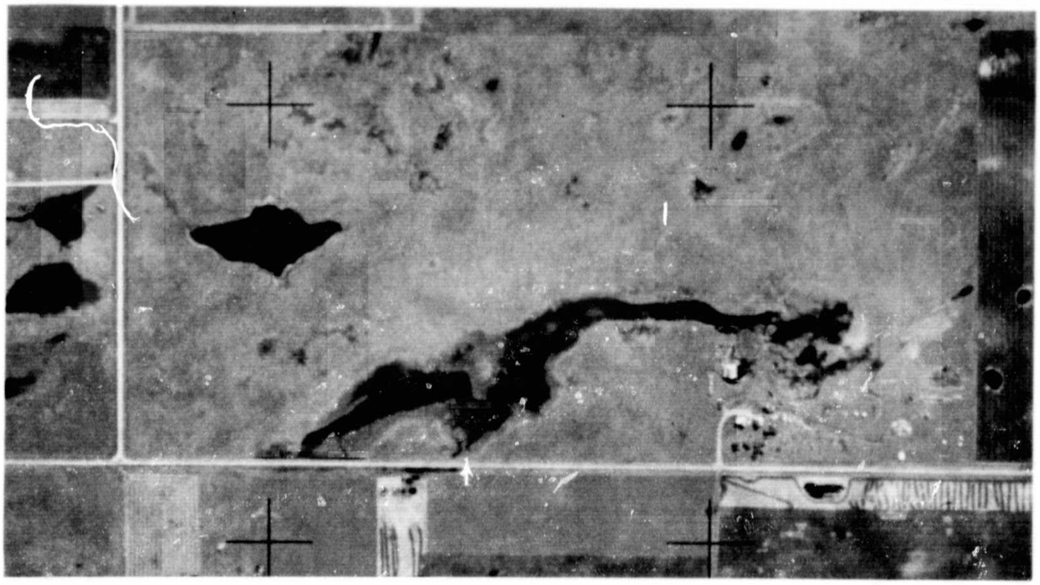
Shallow prairie lakes and reservoirs are included in Type 5. The water is usually less than 3 m (10 feet) deep and emergent vegetation exists only in the shallow margins. Rooted aquatic plants are common in water depths less than 6 feet. Type 5 wetlands provide brood habitat in mid and late summer when less permanent marshes in the area are dry. They are identified by smooth dark tones. Type 4 and inland open fresh water (Type 5) are not very frequent in the area because the deeper morainic depressions associated with the earlier glaciation which generally form the basins of these types were filled when the glacial lake Dakota sediments were deposited.

SUMMARY OF PROGRESS

POTTER COUNTY

The Potter County soil survey for land evaluation is nearing completion. Mapping units are being finalized and the present effort is directed toward determining the proportions of the component soils and assigning dollar values to the units. The maps will be transferred to the Director of Equalization in early summer 1976. Products shown earlier in the report and furnished to the county at the present time are as follows:

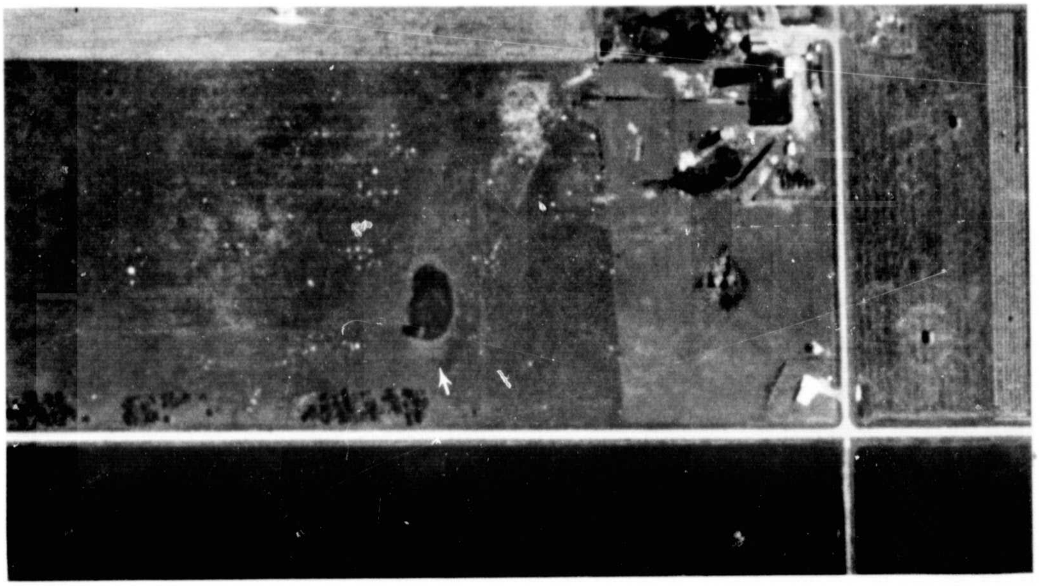
1. General Land Use overlay on June 1974 color composite background at 1:125,000 and 1:250,000.



Color-infrared image of Type 4 wetland. (Scale ≈ 1:8,000 Arrow denotes position of ground-level oblique. RB-57, Ziess, 12" fl, 27 June 75)

Ground-level oblique of the above Type 4 wetland. (27 June 75)

Fig. 11. Example interpretation of Type 4 wetland in the Lake Dakota Plain.



Color-infrared image of Type 4 wetland. (Scale ≈ 1:8,000 Note the peripheral band of vegetation. Arrow denotes position of ground-level oblique. RB-57, Ziess, 12" fl, 27 June 75)

Ground-level oblique of above Type 4 wetland. (27 June 75)

Fig. 12. Example interpretation of Type 4 wetland with a peripheral band of marsh vegetation common to seasonally flooded basins or flats which should be included in the interpreted wetland basin.

2. General Soils map overlay with descriptions on June 1974 color composite background at 1:125,000 and a May 1973 color composite background at 1:250,000.

These items will be used to fulfill data requirements for Countywide land use planning in Potter County. Several interpretations will also accompany the general Soils map. These will be for general soil limitations and agricultural productivity.

The following products will be provided to the Director of Equalization and Potter County planners, respectively, upon completion.

1. A soil survey for land evaluation for tax equalization with soils delineated on large scale black and white photography and photo index sheets.

2. A color infrared mosaic of Potter County for viewing and future planning in the area.

Several news releases on the Potter County Project have been made. An example of their content is given by the one printed in a summer 1975 issue of the Brookings Register and shown in Appendix B. A similar article was printed in the Sioux Falls paper and distributed in an extension newsletter.

WILDLIFE HABITAT

The classification of wetlands for inventory purposes has progressed as follows:

1. Methodology has been developed for recognizing and classifying wetland types on color infrared imagery taken in June 1975.

2. Examples of imagery and methodology have been furnished to those involved and techniques have been reviewed and approved by these cooperating personnel.

3. Mapping of the wetlands in the irrigable region of the Lake Dakota Plain is underway.

ROOFTOP TEMPERATURE SURVEYS

The Remote Sensing Institute has reported on the use of an aerial thermal scanner system to survey apparent rooftop temperatures for entire communities. This successful program is ongoing and has resulted in recent surveys of Sioux City, Iowa (Iowa Public Service) and Watertown, South Dakota (City sponsored), and three cities in Nebraska (Scotts Bluff,

Gerring, and Sidney) have been flown. The City of Brookings has also contracted for a survey. These flights are sponsored by the Kansas-Nebraska Gas Company. Several other groups have contacted RSI concerning flights demonstrating the popularity of this operational applications-oriented program.

WESTERN SOUTH DAKOTA PROJECTS AND RELATED RSI WORK

Several projects have been sponsored by the NASA Office of University Affairs in Western South Dakota. These include the Pennington County project (soil mapping for tax equalization) and the Meade County project. As a result of the satisfaction of the users with these projects and their quality, RSI has been requested to provide land use maps from LANDSAT for seven (update for two) counties in the Black Hills area. The work has been contracted with RSI by the Sixth District Council of Local Governments and their governing body. The results are to form the basic land use data for a nonpoint water pollution study in the area. The data will be entered into a data base for combination with general soils interpretations and other data for area analysis.

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APPENDIX A

AUDITOR'S OFFICE
POTTER COUNTY
GETTYSBURG, S. DAK.

JAN 1975
RECD
Remote Sensing
Institute

January 30, 1975

Doctor C.J. Frazee
Remote Sensing Institue
South Dakota State University
Brookings, South Dakota 57006

RE: ERTS Soil Map and Land value Information, East River Project.

Dear Doctor Frazee:

This is to inform you, that the Potter County Board of Commissioners are very willing to allow our County to be used in your ERTS Soil mapping and land value information project.

We have been approached by Mr. Don Miller, S.D. Department of Revenue, on this matter and appreciate that Potter County is being considered.

Please feel free to contact any County Commissioner or our Director of Equalization, Mr. Robert Borszich, for any assistance or information required on this project.

Sincerely

Wilferd C. Fischer

Wilferd C. Fischer
Chairman Potter County
Board of Commissioners

WCF/rjb

CC: George Winckler

Office of
Director of Equalization
POTTER COUNTY
Gettysburg, South Dakota 57442

19 November 1073

Mr. George Winkler CAE CSDA
Director, Property Tax Division
Pierre, South Dakota

Dear Mr Winkler;

Reference the EROS presentation by Doctor Weston and Doctor Frazee at our recent annual convention.

This County would like you to make the necessary contact with the proper Individual to determine Cost and procedure for us to obtain a colored print, and plastic overlays as displayed on the one county. Further we are also interested in having the same study accomplished on this County, as Doctor Frazee is doing on Pennington County. Please obtain this cost for us.

This letter corrinated with Mr. A. L. Rogers, Chairman Potter County Commissioners.

CC: County Commissioners

Sincerely
Robert J. Bossgich
Director of Equalization

APPENDIX B

Land tax equalization assisted by satellites

Satellite imagery is being used to help some South Dakota counties get needed soil productivity information as they attempt to comply with state laws designed to achieve tax equalization of agricultural lands. Potter County, bordering the Missouri River in the north-central part of the state, is having a remote sensing survey made this summer.

Mostly it is a matter of time and money.

A law passed by the South Dakota legislature in 1970 requires that taxes on agricultural lands be based on productivity of the soils for crops or grass commonly grown in the areas under average management. Detailed soil surveys made since the 1920's by the Soil Conservation Service in cooperation with the South Dakota State University Agricultural Experiment Station are sources of soil inventory data useful for tax purposes. But they are available for only less than half of South Dakota's counties. It would take many years o costly ground surveys to make detailed surveys in the remaining counties.

A soils survey based on LANDSAT (formerly ERTS) satellite imagery, made last year for Pennington County, is now being used by assessors and tax equalization personnel, according to Tracy Cox, soils and land use specialist of the Remote Sensing Institute (RSI) on the SDSU campus. This summer's survey in Potter County will be somewhat more detailed and as a pilot project is being funded by the National Aeronautics and Space Administration (NASA). Several other counties have contacted RSI regarding possibilities of similar surveys.

SURVEYS LESS COSTLY

The generalized soil survey map for Pennington County was completed in less than 2 months of field work costing only a fraction of what a detailed published survey entails. Soils specialists point out that the detailed SCS surveys are essential for many uses, however the "satellite" surveys provide useful, accurate, less costly and more rapidly obtained information related to soil productivity as used for tax equalization.

"The Potter County survey—as would others in East River counties—must have more detail than West River counties because land use is more intensive, the soils more diverse and land holdings are smaller," explains Bernard H. Byrnes, RSI soils specialist, who is assisting in the study. Cox and Byrnes are preparing the map in cooperation with Bob Borszich, Gettysburg, director of equalization in Potter County, and with the South Dakota Department of Revenue. "This means that in addition to LANDSAT satellite imagery we'll also use RB-57 aircraft imagery from 60,000 feet obtained in late June flights over Potter County." LANDSAT satellites orbit South Dakota every nine days and data are available through the EROS Data Center near Sioux Falls.

SOIL PRODUCTIVITY MAPS

Methods to be used by SDSU remote sensing personnel will follow those developed in Pennington County and elsewhere through research by RSI personnel and Frederick C. Westin, professor in the SDSU Plant Science Department. Byrnes says the procedure involves using satellite and aircraft imagery to delineate soils areas shown by different drainage patterns, vegetation, color, and land use. These differences are evident to persons experienced in photo interpretation. The soil boundaries as determined from the imagery are then extensively field checked for accuracy.

Once the "satellite soil survey" maps themselves are completed, it is not difficult to incorporate other data.

A final step, as explained by Byrnes, is encoding data into a computer which provides a printout showing a symbol representing a land value.

This value can be used as a guide for the assessor in land evaluation for those counties without detailed soil surveys.